

A Study on Compliance with Catheter Related Blood Stream Infection (CRBSI) Prevention Protocols in a Rural Tertiary Care Hospital.

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Abstract:

Central line-associated bloodstream infections (CLABSIs) are a major cause of healthcare-associated morbidity and mortality. Adherence to evidence-based central line insertion and maintenance bundles plays a critical role in reducing these infections. This study aimed to evaluate compliance with central line bundle components and identify areas for improvement. **Materials and Methods:** This prospective audit was conducted over a two-year period (January 2022 to December 2023) at a tertiary care teaching hospital. A total of 886 consecutive central venous catheter insertions were included. Both elective and emergency procedures were assessed. Data were collected using a structured proforma based on predefined bundle components, including hand hygiene, aseptic precautions, skin antisepsis, and documentation practices. Observations were recorded and analyzed using descriptive statistics, and results were expressed as frequencies and percentages. **Results:** Among 886 insertions, the majority of patients were aged 22–50 years (514, 58%). Most procedures were performed in critical care units (753, 85%) and by junior residents (third year) (691, 78%). Elective insertions accounted for 780 (88%) cases. The right internal jugular vein was the most common insertion site (673, 76%). Compliance with hand hygiene was observed in 857 (96.7%) cases, aseptic precautions in 837 (94.5%), and appropriate skin antisepsis in 846 (95.5%). Adequate documentation and follow-up until catheter removal were noted in 866 (97.7%) cases. **Conclusions:** High levels of compliance were observed across most central line bundle components. Continued emphasis on training, adherence to protocols, and periodic audits is essential to sustain these practices and further reduce the risk of catheter-related infections.

Key Words: Aseptic technique, Bundle adherence, CLABSI, Infection control practices, Vascular catheter infections

Introduction:

Central line-associated bloodstream infections (CLABSI) continue to pose a significant burden on healthcare systems, particularly within intensive care environments. The reported incidence is less in high-income settings, while considerably higher rates are observed in low- and middle-income countries. ^[1-4] These infections contribute to increased patient morbidity and mortality, longer durations of hospitalization, and greater financial strain on healthcare services. In addition, CLABSI are recognized as preventable adverse events, making them an important indicator of healthcare quality and patient safety. ^[5,6]

Individuals requiring prolonged central venous access are especially vulnerable, including those in critical care units, oncology wards, and haemodialysis programs. Factors such as extended catheter dwell time, lapses in aseptic technique, repeated line manipulations, and underlying comorbidities further elevate the risk. The type of catheter, insertion site, and frequency of access also influence infection risk, with femoral access and multilumen catheters being associated with higher infection rates. ^[7-10] Despite advancements in infection control practices, CLABSI are not confined to intensive care units and remain a notable cause of bloodstream infections in general hospital settings.

Microbiologically, CLABSI are most commonly caused by skin commensals such as coagulase-negative staphylococci and *Staphylococcus aureus*, along with Gram-negative bacilli and fungal pathogens in certain high-risk populations. The pathogenesis often involves microbial colonization of the catheter hub or insertion site, leading to biofilm formation, which complicates treatment and increases the likelihood of persistent infection. ^[11-13]

Implementation of preventive measures—including strict aseptic insertion techniques, use of maximal sterile barrier precautions, chlorhexidine-based skin antisepsis, and adherence to maintenance bundles—has been shown to significantly reduce infection rates. ^[14-16] The use of standardized checklists and care bundles has demonstrated sustained reductions in CLABSI incidence across diverse healthcare settings. Furthermore, strategies such as antimicrobial-impregnated catheters and daily assessment for line necessity have been recommended in high-risk scenarios. Public health authorities at both national and international levels advocate for ongoing surveillance, regular staff education, and consistent use of evidence-based care bundles to minimize these infections. ^[17,18]

From a quality assurance and administrative standpoint, conducting regular audits of bundle adherence is crucial for detecting shortcomings in practice. Continuous monitoring not only improves compliance but also fosters accountability among healthcare providers. Recognizing these deficiencies allows for the development of focused interventions aimed at improving compliance and patient outcomes. Accordingly, the present study was undertaken to evaluate adherence to the CRBSI prevention bundle and to identify specific areas requiring enhancement.

Materials and Methodology:

This prospective audit was conducted at a tertiary care teaching hospital over a two-year period from January 2022 to December 2023. A total of 886 consecutive central venous catheter (CVC) insertions were included. Informed consent was obtained from patients or their legally

authorized representatives prior to inclusion. All the data were related to the adult patients, included both males and females. There was no upper limit of age in inclusion criteria.

Both elective and emergency CVC insertions were considered. Procedures were performed by junior residents and faculty members who had prior experience of at least one independent catheter insertion. Data were recorded using a structured proforma based on predefined parameters (Table 1). The collected data were compiled and analyzed using descriptive statistics. Findings are presented as frequencies and percentages.

S.N	Questions
1	Demographic details of patient- Age, Gender
2	Procedure performed at – Casualty, Critical care unit, Operation theatre, Ward
3	Procedure performed by – Junior resident 1, Junior resident 2, Junior resident 3, Consultant
4	Whether the procedure performed was elective or emergency
5	Site of insertion – Internal jugular vein (Right/Left), Subclavian vein (Right/Left), Femoral vein (Right/Left)
6	Hand Hygiene – Removal of ornaments worn in hands, Hand washing technique,
7	Preventive steps for the infection – Wearing sterile gloves, Mask and headcap, sterile Gown, Proper positioning of the patient,
8	Skin Antisepsis – Choice of antiseptic, Adequacy of quantity used, Dressing technique
9	Daily review of central line – Documentation of daily review and days of insertion and removal details.

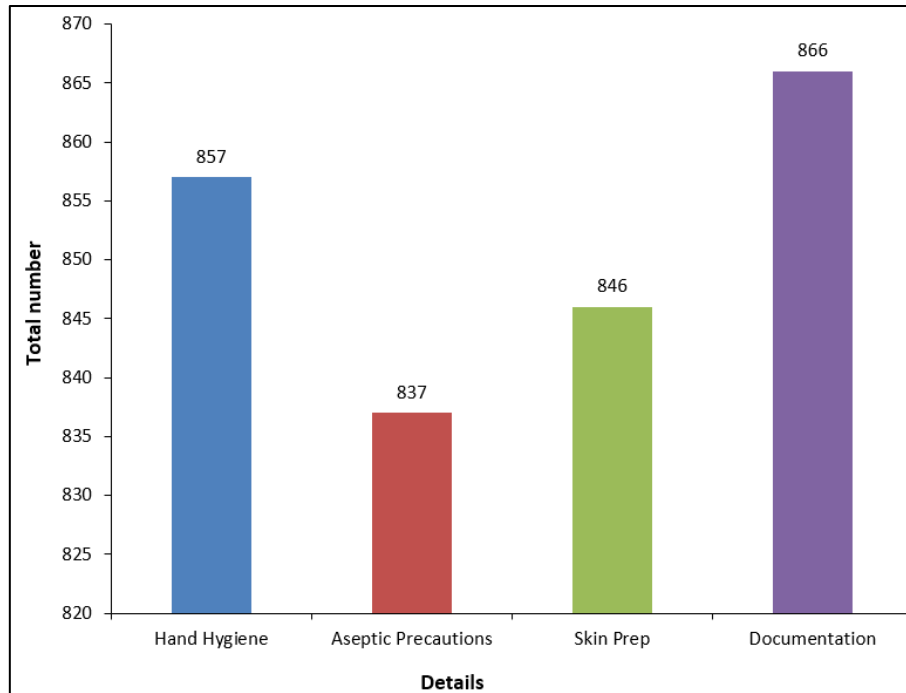
Results:

A total of 886 central line insertion records were collected using the structured proforma. The majority of patients were aged 22–50 years, accounting for 514 (58%), followed by those aged 51–75 years at 284 (32%), and patients older than 75 years at 88 (10%). Central line placements were most commonly performed in the critical care unit, comprising 753 (85%) cases, followed by 89 (10%) in the operation theatre, 27 (3%) in the wards, and 17 (2%) in the casualty.

Most procedures were carried out by junior residents (third year), accounting for 691 (78%), followed by consultants at 89 (10%), and junior residents (second and first year) at 53 (6%) and 53 (6%), respectively. Elective central line insertions were performed in 780 (88%) patients, while 106 (12%) were emergency procedures.

The most common site of catheter insertion was the right internal jugular vein in 673 (76%) cases. Other sites included the left internal jugular vein in 44 (5%), right femoral vein in 89 (10%), left femoral vein in 53 (6%), and right subclavian vein in 27 (3%). Compliance with

hand hygiene practices was observed in 857 (96.7%) procedures. Strict aseptic precautions were followed in 837 (94.5%) cases. Proper skin antiseptic preparation and dressing were documented in 846 (95.5%) cases. Adequate documentation with follow-up until catheter removal was noted in 866 (97.7%) procedures. All the details are depicted in graph 1.



Graph 1: Shows central line bundle compliance across key domains

Discussion:

The central line bundle approach is well established as an effective strategy for reducing catheter-related bloodstream infections (CLABSIs); however, ensuring consistent adherence remains a recognized challenge across healthcare settings. Regular audits are therefore crucial to evaluate compliance patterns and guide quality improvement initiatives.

In the present audit of 886 central line insertions, the majority of procedures were performed in critical care units (85%), which is comparable to previous studies where central venous access is predominantly required for critically ill patients. The high proportion of procedures performed by junior residents (78%) is also consistent with teaching hospital settings, emphasizing the need for continuous supervision and structured training programs to ensure adherence to infection prevention practices.

The preference for the right internal jugular vein (76%) observed in this study aligns with existing literature, where this site is commonly favoured due to its lower complication rates and ease of access. Similar trends have been reported in earlier studies evaluating central line practices. In terms of compliance, this study demonstrated very high adherence to hand hygiene (96.7%) and aseptic precautions (94.5%). These findings are higher than those reported in several earlier audits, where hand hygiene compliance ranged between 70% and 90%. This suggests improved awareness and implementation of infection control practices in the present setting.

Compliance with skin antisepsis (95.5%) in this study was also notably higher compared to earlier reports, where this component often emerged as a major gap. In contrast, previous studies have documented significantly lower adherence to skin antisepsis protocols, identifying it as a critical area requiring improvement. This difference may reflect better institutional enforcement of protocols and availability of standardized supplies in the present study. Documentation and follow-up compliance (97.7%) were also higher than those reported in earlier studies, where documentation-related components were frequently overlooked. Improved documentation in this audit indicates stronger accountability and better integration of checklist-based practices.

Despite these encouraging findings, achieving 100% compliance across all bundle components remains challenging, which is consistent with global literature. For instance, Lee et al. reported full bundle compliance in only 53.7% of cases, while Tripathi et al. demonstrated higher compliance rates of up to 84% in structured settings.^[18,19] These variations highlight the influence of institutional practices, training, and monitoring systems on compliance levels. Furthermore, evidence suggests that initial improvements following bundle implementation may not always be sustained without ongoing education and monitoring. Yilmaz et al. observed a reduction in CLABSI rates shortly after implementation, followed by a subsequent increase, emphasizing the importance of continuous reinforcement.^[20]

The importance of minimizing catheter duration has also been well documented. Studies have shown that prolonged catheterization and extended ICU stays are associated with increased risk of infection, with some reports indicating a daily incremental rise in CLABSI risk. This underscores the need for strict adherence to daily review and timely removal protocols, which showed high compliance in the present study.

Limitations:

A key limitation of this study is that it did not differentiate between landmark-guided (blind) and ultrasound-guided central venous catheter insertions, which may have influenced procedural success rates and compliance with aseptic practices. Additionally, the specific clinical indications for central line placement were not categorized or analyzed. As a result, potential variations in practice patterns based on indication or technique could not be assessed, limiting the ability to draw more detailed conclusions regarding factors influencing compliance and outcomes.

Conclusion:

This audit demonstrated good compliance with the hand hygiene and barrier precaution elements of the CRBSI prevention bundle. Documentation pertaining to the need for catheter continuation and timely removal was also found to be adequate. However, there is a need for continued efforts to maintain and further improve adherence. Focused training programs, use of checklists to empower assisting staff, and periodic re-audits are recommended to sustain high standards of practice. Additionally, it is essential to orient all newly joined residents and faculty members to institutional protocols and standard operating procedures, along with enhancing awareness regarding CRBSI prevention.

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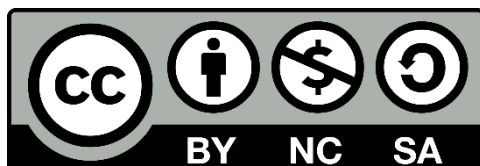
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